BIENNIAL RESEARCH SUMMARY

A. TASK # 147-14-20-10 Aircraft Deployment
TASK # 147-14-30-10 Airborne Arctic Stratospheric Expedition

B. INVESTIGATORS AND INSTITUTIONS

PROJECT MANAGER Estelle Condon, Earth System Science Division
Ames Research Center, Moffett Field, CA.
PROJECT SCIENTIST Adrian Tuck, NOAA Aeronomy Laboratory,
Boulder, Col. 80303
DEPUTY MANAGER Steve Hipskind, Earth System Science Division
Ames Research Center, Moffett Field, CA.
SCIENCE COORDINATOR Brian Toon, Earth System Science Division
Ames Research Center, Moffett Field, CA.
SCIENCE COORDINATOR Steve Wegener, Earth System Science Division
Ames Research Center, Moffett Field, CA.

C. RESEARCH OBJECTIVES

The Airborne Arctic Stratospheric Expedition had two primary objectives: 1. To study the production and loss mechanisms of ozone in the north polar stratosphere and 2. to study the effect on ozone distribution of the Arctic Polar Vortex and of the cold temperatures associated with the formation of Polar Stratospheric Clouds (PSC's).

D. SUMMARY OF PROGRESS AND RESULTS

Two specially instrumented NASA aircraft, a high altitude ER-2 aircraft, and a DC-8 flying laboratory were flown over the Arctic region during January and February 1989. The aircraft were operated from Stavanger, Norway. Each aircraft flew a total of 14 flights over the Arctic region to acquire data on the meteorological, chemical and cloud physical phenomena that occur in the polar stratosphere during winter. Measurements were made during the statistically most active period for the formation of Polar Stratospheric Clouds. Extensive systems of polar stratospheric clouds were observed by experiments on both aircraft. The chemical processes which occur in the polar stratosphere during winter were also observed and studied. The data acquired are currently being analyzed in detail and prepared for publication.

E. PUBLICATIONS

The Planning and Execution of the ER-2 and DC-8 Aircraft Flights Over Antarctica, August and September 1987. A.F. Tuck, R.T. Watson, E.P. Condon, J.J. Margitan, O.B. Toon, J. Geophys. Res., in press (1989).

RESEARCH SUMMARY

A. Title of Task: Antarctic Ozone Project

B. Investigators and Institutions: Arlin J. Krueger
Atmospheric Chemistry and Dynamics Branch

C. Abstract

Antarctic springtime total ozone has decreased to record low levels since 1980. Special, quick-look processing of TOMS data is needed to obtain timely information on the state of the ozone hole for use by scientists who are collecting complementary data in the field, as well as for NASA stratosphere program scientists. Raw satellite data are processed and converted to global ozone maps within a day for transmission to the Antarctic and other locations. The total ozone data are compared with atmospheric temperature and pressure data in seeking an explanation for differences in the depth of the ozone hole from year to year. Although the Arctic pole has a different dynamical behavior from the Antarctic, the chemical depletion by chlorine is expected to be similar. The Arctic TOMS data need to be examined for evidence of such depletion even though a feature like the Antarctic ozone hole is not present.

D. Summary of Progress and Results

The development of the 1988 Antarctic ozone hole was observed in quick-look TOMS data from August 21 through November 17, 1988. Contour maps of total ozone were transmitted to McMurdo station for use in planning balloon sounding operations. Color images were made for analysis and domestic distribution.

The 1988 Antarctic ozone hole season began with a series of local deepenings in the region just outside the polar night during August. A distorted ozone minimum, displaced from the pole to Pacific longitudes, appeared in September. This minimum failed to deepen significantly in October, resulting in a behavior similar to 1982, prior to the time of the very strong ozone depletions found in 1985 and 1987. By contrast, during September 1987 rapid, substantial total ozone decreases were found and extremely low ozone continued to exist throughout October and November.

The 1989 Airborne Arctic Stratospheric Expedition was supported by real time TOMS data production which began on December 27, 1988 and concluded on February 16, 1989. Quick-look processing continued through mid-March to track evolution of the polar ozone field following the completion of aircraft operations.

The Arctic ozone field was similar to prior years in December and into January. At the end of the month an unusual mini-hole formed over the North sea and Scandinavia, with the center close to Oslo, Norway. This coincided with shifts of the polar vortex and preceded a split of the vortex in Mid-February. The vortex branches then became displaced over Eastern Siberia and Baffin Island where they were easily recognizable on the TOMS maps as deep ozone minima.

The 1989 Antarctic spring will be observed in August - November with quick-look processing and data will be transmitted to Antarctic sites. The Arctic regions may similarly be observed during January - March 1990.

E. Publications

Krueger, A. J., L. M. Penn, D. E. Larko, S. D. Doiron, and P. T. Guimaraes, The 1988 Antarctic Ozone Hole: The Nimbus 7 TOMS Data Atlas, NASA Ref. Publ. 1225, August 1989.

Krueger, A. J., L. M. Penn, D. E. Larko, S. D. Doiron, and P. T. Guimaraes, The 1989 Airborne Arctic Stratospheric Expedition: The Nimbus 7 TOMS Data Atlas, NASA Ref. Publ 1227, July 1989.

Krueger, A. J., R. S. Stolarski, and M. R. Schoeberl, The 1987 Antarctic Ozone Hole: A new record low, Geophys Res. Lett, 15, 1365-1368, 1988.

Krueger, A. J., R. S. Stolarski, and M. R. Schoeberl, Formation of the 1988 Antarctic Ozone hole, Geophys Res. Lett, 16, 381-384, 1989.